

PLUNGING SIDESHAFT ASSEMBLY WITH VL JOINT

Background Of The Invention

[0001] The invention relates to a driveshaft and, more particularly, concerns a sideshaft in a motor vehicle having two constant velocity universal joints and an intermediate shaft. The intermediate shaft comprises a longitudinal plunging unit including a sleeve with first ball grooves which extend axially, a journal with second ball grooves which extend axially, balls which are held in groups in pairs of grooves each comprising a first ball groove and a second ball groove, and a cage which holds the balls at a fixed distance from one another. The primary requirements for such sideshafts are easy plungeability, easy assembly and handling, and a quiet and long service life. The present invention is directed towards an improved plunging sideshaft assembly.

Summary Of The Invention

[0002] The invention provides a driveshaft, such as a sideshaft in a motor vehicle, which comprises two fixed joints and a longitudinal plunging unit integrated into the intermediate shaft. At least one of the fixed joints, more particularly, the sideshaft joint at the differential end, is made to be particularly small and easy to assemble. According to one solution, one of the constant velocity universal joints comprises an outer joint part with first ball tracks which form a first angle of intersection with the joint axis, an inner joint part with second ball tracks which form a second angle of intersection with the joint axis, balls which run in pairs of tracks consisting of a first ball track and a second ball track, and a cage

which holds the balls in a common plane, wherein the first and second angles of intersection of the ball tracks of a pair of tracks are identical in size and are positioned symmetrically relative to the joint axis and wherein the ball cage is axially fixed in the constant velocity joint.

[0003] In one embodiment, the ball cage comprises an inner cylindrical guiding face in which the inner joint part is held radially, and a spherical outer face which is held axially and radially between two annular stop faces.

[0004] In a second embodiment, the fixed joint includes a ball cage having an inner cylindrical guiding face in which the inner joint part is held radially, and a spherical outer face which is held radially in an inner cylindrical guiding face of the outer joint part. The ball cage is supported in a first direction on a first annular stop face in the outer joint part, and the inner joint part is supported in a second axial direction on a second annular stop face in the ball cage.

[0005] In a third embodiment, the fixed joint includes a ball cage including an inner cylindrical guiding face in which the inner joint part is held, and a spherical outer face which is radially held in an inner cylindrical guiding face of the outer joint part. The inner joint part is supported in a first axial direction on an annular stop face in the ball cage, and in a second axial direction, it is supported on a radial end face of the outer joint part.

[0006] The inventive fixed joints essentially correspond to a VL plunging joint with intersecting pairs of tracks, but as a result of suitable stop faces in the joint, the axial plunging ability of the cage relative to the inner joint part and outer joint part, and thus relative to the joint as a whole, is fixed. Joints of this type are very lightweight and have a small diameter

relative to the torque transmitting capacity and are thus advantageous as far as production is concerned. To achieve the axial non-plungeability, in accordance with the first embodiment mentioned above, only the base part and the attaching cap part require slight modification relative to the configuration of a typical VL plunging joint. According to the second embodiment, it differs from a conventional VL plunging joint by modifications to the base part and the cage, and respectively, the cap part and the cage. Finally, according to the third embodiment, only slight modifications relative to typical VL joints have to be carried out on the cage and the inner joint part.

[0007] The solution in accordance with the various embodiments of the invention permits the production of lightweight, cost-effective shafts and, more particularly, sideshafts which, as a result of the integrated longitudinal plunging unit, feature low axial plunging forces and thus an advantageous NVH (noise-vibration-harshness) behavior.

[0008] Other advantages and features of the invention will also become apparent upon reading the following detailed description and appended claims, and upon reference to the accompanying drawings.

Brief Description Of The Drawings

[0009] For a more complete understanding of this invention, reference should now be made to the embodiments illustrated in greater detail in the accompanying drawings and described below by way of examples of the invention.

[0010] Figures 1 to 7, in seven different embodiments, show part of a driveshaft with a fixed joint and a longitudinal plunging unit in axial sections:

- A) Through a plane which intersects two torque transmitting balls;
- B) through a plane which is positioned between balls of the fixed joint.

[0011] Figure 8 shows an inventive joint according to Figure 3A in a partially dismantled condition:

- A) In an axial view; and
- B) in a longitudinal section through a plane B-B which intersects two balls.

Detailed Description

[0012] The common characteristics of Figures 1 to 7 will first be described jointly. The figures each show a fixed joint 11 and a longitudinal plunging unit 41 forming part of an intermediate shaft. The fixed joint 11 comprises an outer joint part 12 having an annular member 13 containing first ball tracks 14, a base part 15 (Figures 1, 2, 6, and 7) and 29 (Figures 3, 4, 5) respectively, and an annular attaching cap 16. The attaching cap 16 can be made of plate metal and serves to fix a convoluted boot for sealing the joint. Furthermore, the joint comprises an inner joint part 17 with second ball tracks 18. Torque transmitting balls 19 are positioned in pairs of first ball tracks 14 and second ball tracks 18. The first ball tracks 14 form a first angle of intersection with the joint axis A, and the second ball tracks 18 form a second angle of intersection with the joint axis A. The first and second angles of intersection of the ball tracks 14, 18 of a pair of ball tracks are identical in size and are positioned symmetrically relative to the joint axis A. The balls 19 are held in a ball cage 20 which is provided with

circumferentially distributed cage windows 21. The ball cage 20 holds the balls 19 in a common plane E and is axially fixed in the constant velocity joint 11. A shaft journal 22 is connected to the inner joint part 17.

[0013] The longitudinal plunging unit 41 comprises a sleeve 42 with first ball grooves 43, a journal 44 with second ball grooves 45, torque transmitting balls 46 running in pairs of first ball grooves 43 and second ball grooves 45, as well as a ball cage 47 which holds the balls at a constant distance from one another. The journal 22 of the inner joint part is integral with the journal 44 of the axial plunging unit.

[0014] In Figure 1, the base 15 is provided in the form of a solid component with an adjoining joint journal 23. The annular part 13, the base part 15 and the attaching cap 16 are threaded to one another by threaded fasteners 24. The inner joint part 17 is integrally connected to the shaft journal 22. In the cage 20, there is provided an inner cylindrical guiding face 31 in which the inner joint part 17 is held radially by way of a spherical outer face 28. In the annular part 13, there is formed an inner cylindrical guiding face 25 and first annular stop face 26 against which the cage 20 is supported by way of its spherical outer face 39 in a first axial direction R1. In the base part 15, there is formed a second annular stop face 27 which axially supports the cage 20 in a second axial direction R2. As the first ball tracks 14 and the second ball tracks 18 intersect one another in pairs in space, the axial fixing of the cage 20 in the outer joint part 12 also prevents the displacement of the inner joint part 17 relative to the cage 20.

[0015] In Figure 2, any details identical to those shown in Figure 1 have been given the same reference numbers. To that extent, reference is made to the description of Figure 1. Figure 2 deviates from Figure 1 in that

the shaft journal 22 is inserted into the inner joint part 17. In addition, the shaft journal 22 and the journal 44 integrally connected thereto are provided in the form of hollow journals. The inner joint part 17 does not comprise a purely spherical outer face, but an outer face 28 which includes a spherical portion 28 and two conical faces 37, 38.

[0016] In Figure 3, any details identical to those in Figure 1 have been given the same reference numbers. To that extent, reference is made to Figure 1. The shaft journal 22, just like the journal 22 in Figure 1, is produced so as to be integrally connected to the inner joint part 17. Figure 3 deviates from Figure 1 in that the base part is provided in the form of a plate metal cover 29 in which, however, the second stop face 27 is arranged in the same way as in the embodiment according to Figure 1. The connection of the outer joint part 12 with an attaching part has to be effected directly via the annular member 13.

[0017] In Figure 4, any details identical to those shown in Figure 1 have been given the same reference numbers. To that extent, reference is made to the description of Figure 1. The shaft journal 22 is provided in the form of a hollow journal, as in Figure 2, but it is attached to the inner joint part 17 via a friction weld 30. The shape of the inner joint part 17 is as described in connection with Figure 2. The plate metal cover 29 has the shape as already described in connection with Figure 3. To that extent, reference is made to the respective descriptions.

[0018] In Figure 5, any details identical to those shown in Figure 1 have been given the same reference numbers. To that extent, reference is made to the description of Figure 1. The shaft journal 22 and the journal 44 have the same shape as that shown in Figure 1. The plate metal cover 29

corresponds to the embodiment illustrated in Figures 3 and 4. The annular member 13 deviates from the above-mentioned embodiments in that it comprises an inner cylindrical guiding face 25 which only permits radial support for the spherical outer face 28 of the cage 20. Instead, the cage 20 comprises an inner cylindrical guiding face 31 which radially supports the inner joint part 17, as well as an annular stop face 32 on which the inner joint part 17 is radially supported in the first axial direction R1. In addition, as in the preceding embodiments, the cage 20 is supported in the second axial direction R2 on the annular second stop face 27 in the plate metal cover 29.

[0019] In Figure 6, any details identical to those shown in Figure 1 have been given the same reference numbers. To that extent, reference is made to the description of Figure 1. In particular, the shaft journal 22 and the journal 44 are designed as shown in Figure 1. As in the previous Figure 5, in this case, too, the inner guiding face 25 of the annular member 13 is purely cylindrical and serves only to provide radial guidance for the cage 20. The attaching cap 16 is designed in such a way that it forms the first annular stop face 26 for the cage 20 on which the cage 20 is supported in a first axial direction R1. The base 15 is a solid part and produced so as to be integral with a joint journal 23, but widened on the inside in such a way that it is not in contact with the cage 20. Instead, the cage 20 itself comprises an inner cylindrical guiding face 31 and an annular stop face 33 which axially supports the inner joint part 17 in a second direction R2.

[0020] In Figure 7, any details identical to those shown in Figure 1 have been given the same reference numbers. To that extent, reference is made to the description of Figure 1. In particular, the shaft journal 22 is produced so as to be integral with the inner joint part 17 and the journal 44

and designed in the same way as shown in Figure 1. The annular member 13 comprises an inner purely cylindrical guiding face 25 which supports the cage in the radial direction only. As in Figure 5, the cage comprises an inner guiding face 31 and an annular stop face 32 which axially supports the inner joint part 17 in the first direction R1. The base 15 which is provided in the form of a solid part and is connected to the joint journal 23 is again widened in such a way that it has no contact with the cage 20, as shown in Figure 6. A central stop member 35 which is axially supported in the second direction R2 on a stop face 36 in the base is inserted into the inner joint part 17.

[0021] In Figure 8, the front closing cap 16 has been removed, whereas all the remaining details correspond to those of Figure 3. In the plan view of the annular member 13 it can be seen that the first ball tracks 14 of the outer joint part form alternating first angles of intersection with the joint axis A. In the plan view of the inner joint part 17 it can be seen that the second ball tracks 18 of the inner joint part form alternating second angles of intersection with the joint axis A. First and second ball tracks 14, 18 associated with one another form angles of intersection which are identical in size and which are symmetric relative to the joint axis A. The first and second ball tracks associated with one another accommodate a ball 19. The balls 19 are all held in a cage 20.

[0022] While the invention has been described in connection with several embodiments, it should be understood that the invention is not limited to those embodiments. Rather, the invention covers all alternatives, modifications, and equivalents as may be included in the spirit and scope of the appended claims.